Additional research is needed to scale visual complexity. A completely reliable scale may be impossible to produce, but from a practical perspective it may be perfectly adequate to reliably characterize the extreme ends of the complexity dimensions. The low end would define locations where sign maintenance is less important and the high end would define locations where special attention may be necessary. This may be the simplest way that a visual complexity scale would have useful application.

Another area that needs attention is sign position and its effect on the luminance available at the driver's eye level. In some situations, depending on road curvature and grade, sign position will have a greater impact on available luminance than sign size and specific luminance.

NIGHT WORK ZONE REFLECTORIZATION

Frank D. Shepard, Virginia Highway and Transportation Research Council

The country has witnessed a past era of building super highways capable of handling high volumes of traffic traveling at high speeds.

Rehabilitation of the superhighways constructed over the past few decades is becoming increasingly difficult because of increasing travel demand. Because many highways operate at or near capacity for long periods, the time during which maintenance operations can be effectively conducted is restricted. In many areas it is nearly impossible to close one or more lanes during the day, especially during morning and afternoon peak periods, without backing up traffic for miles. This necessitates the use of alternatives to typical freeway rehabilitation procedures, and sometimes the only alternative is to work at night, which is the only time that traffic volumes are low enough to allow lane closures without creating excessive congestion, and it is usually the last alternative chosen.

There are numerous reasons that night operations are unpopular; the concern for safety is one of the most important reasons. Night operations require that men and equipment be on a road illuminated either by existing street lighting or special illumination. It is emphasized that the work is done only at night and that the highway is reopened to traffic during the day.

In addition to closing one or more lanes, many states close the entire roadway and detour traffic to alternate routes. The night-only operation coupled with road closures can then present motorist situations that are unexpected, and enough has been said about "driver expectancy" to indicate the possible consequences of creating unexpected situations. The problem is compounded by low traffic volumes that lead to higher speeds.

All of these factors dictate that special measures be taken to keep the number and severity of night-work zone accidents at a minimum. Traffic control plays an important role in ensuring safety, and signing devices are important aids in assuring safety in night-work zones.

The Manual on Uniform Traffic Control Devices (MUTCD) states that traffic control should:

- Fulfill a need;
 Command attention;
- 3. Convey a clear, simple meaning;
- 4. Command the respect of road users; and
- 5. Give adequate time for proper response.

In the case of the latter, signs should be simple and legible, especially with the array of lights used during night operations (e.g., the variable message signs, work-site delineation and lighting, and equipment warning lights). Here, the provision and maintenance of reflectorization are quite important. A project initiated at the Virginia Highway and Transportation Research Council will evaluate the legibility of warning signs by using encapsulated lens sheeting. Legibility distance has been increased by about 15 percent through the use of modified lettering on various signs, and plans are underway to analyze legibility versus modified lettering for construction and warning signs.

In addition to signs, various devices are being used to channel traffic in night-work zones, including cones with internal lights or reflectorized sleeves on top, Type II barricades, chevrons of different sizes, and barrels. The spacing and proximity of these channelization devices to the work zones appears to vary. It is important that the detection and legibility distances be optimized, and here reflectorization is extremely important. Uniformity in the use of these devices is also important for night operations.

The variety of traffic control measures being used during night maintenance operations points up the need for research on sign complexity and reflectorization.

REFLECTORIZED INFORMATION NEEDS: WET PAVEMENT

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Whenever the pavement surface reflects light in a manner similar to the way a mirror does, pavement markings disappear from view. Drivers are deprived of guidance cues that they have learned to use and depend on, and a hazardous driving environment exists. The wider the roadway, the more dependent drivers are on lane markings and channelization markings such as for two or more parallel turn lanes, mandatory turn lanes, and "no turn" lanes. The safety value of yellow center lines, double solid yellow "no passing" zones, and two-way left-turn lanes are lost when the road surface is glazed with water or covered with mud or any other material such as spilled liquids or powders that conceal the painted markings on the pavement. Pedestrian crosswalks and stop bars can also lie concealed under a reflecting film that does not affect the pedestrian's view because they are looking down directly at the markings, whereas the driver's eyes are looking ahead at a shallow angle.

Nighttime driving scenes are likely to be more hazardous when the pavement is wet than on the same roadway in daylight. However, daytime scenes also can become a problem, especially when low sun angles are encountered or during bright overcast sky conditions. In urban areas the night scenes are likely to include advertising lights and signs. Even street lighting can create glare on wet streets that not only conceals pavement markings, but also constitutes glare sources at discomfort levels and occasionally at disabling glare levels. The safety implications of sign driving conditions are readily appreciated because they are so obvious.

More subtle safety problems occur when there exists other visual cues that are misleading, such as pavement joints, roadside shrubs and trees,